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27 NOV 1967

MEMORANDUM FOR: Deputy Director for Science and Technology

SUBJECT: Analysis of Surface to Air Missile Engagements for OXCART Missions BX6732 and BX6734

1. This memorandum is for information only.

2. BLACK SHIELD Missions BX6732 and BX6734 were flown on 28 and 30 October 1967 in response to a continuing United States Intelligence Board requirement to maintain photographic surveillance of North Vietnam in order to detect the possible introduction of surface to surface missile systems. These missions were the sixteenth and eighteenth BLACK SHIELD missions flown since the commencement of operations from Kadena Air Base, Okinawa, on 31 May 1967 and are the only missions on which SAM firings have been encountered.

3. The data contained in this memorandum results from an analysis of all source information which includes:

a. Communications Intelligence

b. Electronic Intelligence

c. Photography

d. Electronic Warfare Systems Operation

e. Pilots Comments

f. Hardware Analysis

This memorandum represents the coordinated views of the Office of Special Activities, Office of Scientific Intelligence and the Office of Elint.

4. Mission Resume:

a. Mission BX6732

The mission aircraft departed Kadena Air Base at 0230Z on 28 October 1967 for a route which included two photographic passes over North Vietnam. Attachment I depicts the actual route flown as reconstructed from the INS tape. (For identification purposes the first pass is labeled 32A, the second 32B.) The first actual surface to air missile launched against a BIACK SHIELD aircraft took place on pass 32B. One missile was fired. This missile firing is analyzed in detail in paragraph 5. The planned route was flown as scheduled.

b. Mission BX6734

The mission aircraft departed Kadena Air Base at 0219Z on 30 October 1967. Planned routes included two photographic passes over North Vietnam. Attachment II depicts the actual route flown as reconstructed from mission photography. (For identification purposes, the first pass is labeled 34A, the second pass 34B.) On this mission at least seven and possibly as many as ten surface to air missiles were launched against the mission aircraft. A single missile was launched during pass 34A, the remainder on pass 34B. (It cannot be readily determined whether or not the missile launched on pass 34A was fired at the mission aircraft; however, analysis of pass 34A is included so as to yield as complete a picture as possible of the Air Defense Network.) This mission was flown as scheduled, landing at Kadena Air Base at 0603Z. Post flight inspection of the aircraft revealed a fragment (presumably debris from a SAM but not part of the warhead) had penetrated the right aft fillet of the mission aircraft and had lodged in the support structure surrounding the number five fuel tank. Detailed analysis of the missile firings is contained in paragraphs 8 and 12.

5. Detailed Analysis of BX6732 (Pass 32B)

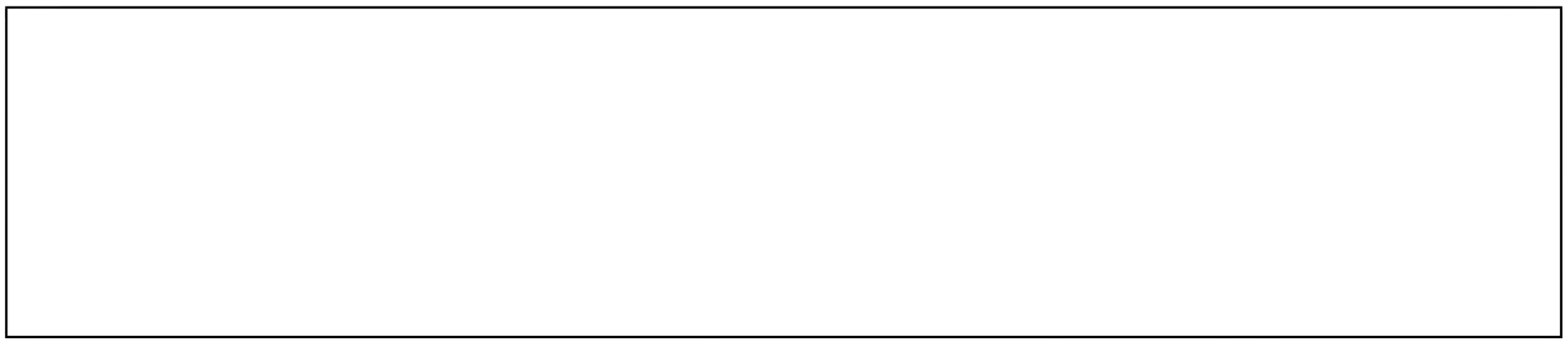
From Elint - Sixty nautical miles to the west of Hanoi (See Attachment III) the on-board System VI Elint Collector detected a single FAN SONG illuminating the mission aircraft. Sequentially, System VI indicated the following activity:

0507:21Z	=	FAN SONG up low PRF
0507:25Z	=	FAN SONG dow low PRF
0507:30Z	=	FAN SONG up low PRF
0508:02.5Z	=	MAD MOTH Jammer On
0508:36.8Z	=	L-band guidance signal up indicating missile launch
0508:44.2Z	=	BLUE DOG Jammer on indicating missile launch
0508:44.5Z	=	FAN SONG up High PRF
0509:40.1Z	=	FAN SONG High PRF and L-Band guidance down
0509:53.5Z	=	MAD MOTH down
0509:54Z	=	FAN SONG to Low PRF
0511:53Z	=	FAN SONG down

From Comint - Intercepted SAM communications revealed that the Phuc Yen Regimental Controller had alerted SAM Site VN133 to ready his missiles and engage the mission aircraft. At 0508Z the site was ordered to fire when the aircraft was about 32 nautical miles from the site. VN 133 did not fire until the mission aircraft was 25.5

nautical miles slant range from site. Post launch communications between the regimental controller and the site revealed that the site was able to fire only one missile in the engagement.

From Photography - Mission photography of a missile taken about 40 seconds after launch revealed the missile to be heading to the left, down, and away from the aircraft flight path. In addition, mission photography of the launch site revealed that only one missile launcher was elevated.



From Pilot's Comments - Other than cockpit light displays from the Electronic Warfare Systems activations, the pilot observed no hostile reactions (contrails, missiles, etc.).

6. Summary - Mission BX6732

Conclusions resulting from analysis of Mission BX6732 data are:

a. One missile was launched at the mission aircraft.

b. Missile launch occurred at a range other than that range required for a successful intercept of the mission aircraft.

c. The on-board Electronic Warfare Systems all responded to the threat.

d. Due to the late launch time of the missile, the mission aircraft was beyond the threat envelope for this engagement as a result of speed and altitude.

7. Significant Findings:

a. Low PRF launch capability was demonstrated for the first time on this mission.

b. Launch Angle Change - Comint derived from SAM chatter during the missile firing indicated a launch azimuth which leads target azimuth by approximately 23 degrees. While this amount of lead is believed excessive for successful missile capture, it may indicate a desire to modify launch tactics for the BLACK SHIELD target parameters. It is also quite likely that the indicated launch azimuth of 240 degrees is in error; occurring either during the post launch analysis conducted by the site, or during the post launch report transmitted to the regimental controller. The error indicated in the SAM track position plot of the mission vehicle shown in Attachment III tends to support this postulate.

The two significant findings as a result of BX6732 will be discussed along with their implications later in this memorandum along with the results of the analysis of BX6734.

8. Detailed analysis of BX6734 (Pass 34A).

From Elint - As the mission aircraft penetrated denied territory, the System VI recorded a single FAN SONG signal. Sequentially the System VI indicated the following activity:

0344:08Z = FAN SONG up low PRF

0345:31Z = L-band guidance up indicating missile launch

0345:37Z = FAN SONG to High PRF

0345:38.9Z = BLUE DOG Jammer up indicating missile guidance

0346:19Z = MAD MOTH Jammer up for 90 milliseconds

0346:29Z = FAN SONG moves out-of-sector still in High PRF

0346:32Z = L-Band guidance and BLUE DOG down

0347:14Z = FAN SONG down

From Comint - Two SAM sites (#234 and #142) were noted active from intercepted communications during pass 34A. Comint relative to these two sites did not yield any evidence of a missile launch, and it is considered highly doubtful that either of these sites would attempt a launch against the mission aircraft since the closest point of approach to either of these sites was in excess of 25 nautical miles.

From Photography - Mission photography on Pass 34A did not reflect a missile launch (no observation of vapor trails, radar or launcher orientation, etc.).

[redacted]

9. Summary - Mission BX6734, Pass A

Conclusions resulting from the analysis of mission BX6734 Pass A data are:

a. While the evidence available does not conclusively demonstrate that a surface to air missile was launched at the mission aircraft, the on-board Electronic Warfare Systems operation and System VI recordings showed signals of the proper timing and sequence for a missile launch.

b. FAN SONG signal intercepts on System VI suggest a lower than normal signal level. As a result it is most probable that the threshold sensitivity of the PIN PEG and MAD MOTH systems were not exceeded. The BLUE DOG system, which is a more sensitive system, responded to the threat for a period of approximately 55 seconds.

c. Since DOD strike aircraft were in the vicinity during the missile launch it is also possible that the missile was directed against these aircraft.

10. Significant Findings

a. The firing sequence of the Low PRF launch mode of Pass 34A is similar to the firing sequence noted in Pass 32B.

b. The L-Band guidance signal was up for 61 seconds indicating either a removal of the guidance computer recycle clock or an extension of the recycle clock time. The guidance computer recycle time was approximately 55 seconds.

11. Detailed Analysis of BX6734 (Pass 34B)

From Elint - Approximately sixty nautical miles west of Hanoi the System VI indicated the presence of FAN SONG low PRF signals. Subsequently System VI indicated the following activity:

0454:33Z	=	FAN SONG up Low PRF
0454:37Z	=	FAN SONG down Low PRF
0454:43Z	=	FAN SONG up Low PRF
0456:11Z	=	MAD MOTH Jammer up
0456:11Z	=	L-Band guidance "A" up
0456:13Z	=	L-Band guidance "B" up
0456:12Z	=	MAD MOTH responded to a dense concentration of high and low PRF FAN SONG signals emanating from at least six SAM sites until 0457:58 when the aircraft was approximately fifteen nautical miles to the east of Hanoi.
0456:18Z	=	BLUE DOG "A" up (associated with L-Band guidance "A")
0456:21Z	=	BLUE DOG "B" up (associated with L-Band guidance "B")

0456:28Z	=	BLUE DOG "C" up
0456:30Z	=	Numerous L-Band guidance signals
0456:30Z	=	BLUE DOG "D" up
0456:41Z	=	BLUE DOG "E" up
0456:43Z	=	BLUE DOG "F" up
0457:12Z	=	BLUE DOG "B" down
0457:16Z	=	BLUE DOG "C" down
0457:18Z	=	BLUE DOG "D" down
0457:29Z	=	BLUE DOG "F" down
0457:38Z	=	BLUE DOG "E" down
0457:58Z	=	MAD MOTH down
0458:54Z	=	BLUE DOG "A" and L-Band "A" guidance down
0459:49Z	=	FAN SONG Activity ceased

From Comint reflections - During the period 0455Z to 0459Z, Comint reflections of pass 34B indicated that SAM Battalions of two Regiments (Phuc Yen and Hanoi) were actively tracking and attempting launches on the BLACK SHIELD vehicle. Comint indicated that the SAM Battalions located at sites #234, #133, #142, and at least two unlocated sites were active during this time.

From Photography - BLACK SHIELD photography of pass 34B established that 13 SA-2 sites were occupied. Analysis of six SA-2 vapor trails which appeared in photography taken from 0457:04Z to 0457:18Z indicated that sites; #234, #244, #133, and a newly identified site located west of Hanoi launched a total of five missiles in the direction of the BLACK SHIELD vehicle. No information could be obtained from the sixth vapor trail that would indicate its launch site. (See Attachment VII) Additional photography of sites #14 and #142 indicated that several launchers (3 and 2 from #14 and #142 respectively) and their FAN SONG radars were pointed in the direction of the BLACK SHIELD vehicle. Analysis of all data indicates that sites #234, #133, #142, #14, #244, and the new site were active and most probably launched six to nine missiles at the aircraft.

From Pilot's Comments - When the Electronic Warfare System activity appeared in the cockpit the pilot extended his rear view periscope in an attempt to make visual contact. The pilot's report is quoted:

"The missiles were in a steep climb through the aircraft altitude of approximately 83,500 feet, then they made a sharp push over to a moderate dive angle, leveled out at my altitude and guided toward the stern of the aircraft to detonation. The missiles varied slightly in azimuth compared to my line of flight in their climb, but all corrected in azimuth

to an accurate dead stern position during push over and dive phase. (Missile altitude) estimated 90,000 feet is probably quite close, but could vary a few thousand feet either way. It was not possible to view the entire contrail until down track a few miles due to narrow angle view in rear periscope." (In this encounter the pilot was referring to three missiles.)

Additionally, pilot reported observing a missile approximately 100 to 200 yards to the right of the aircraft abeam the cockpit. It was in a 70 to 80 degree climb angle in the direction of aircraft flight. The missile was reported to have been rotating fairly fast about its vertical axis and appeared to the pilot to be the last detonation be observed as quoted in paragraph above. In summary the pilot felt that he saw at least six missile contrails and three detonations all to the rear of the aircraft.

12. Summary of Mission BX6734 (Pass 34B)

Conclusions resulting from analysis of BX6734B data are:

a. At least six and possibly as many as nine surface to air missiles were launched at the mission aircraft.

b. System VI analysis indicates the Electronic Warfare Systems performed as designed in jamming a multi signal environment. (See Attachment XI and XII for typical response).

13. Significant Findings

a. Although not readily apparent it appears that the Low PRF launch mode was employed on at least the first two firings of pass 34B. The signal density following these launches precludes any statements regarding Low PRF launch of the other firings.

b. The guidance computer recycle time of 55 seconds has apparently been extended or the clock removed from the system as evidenced by the duration of the L-Band guidance signals (34A, 61 seconds - 34B, 163 seconds).

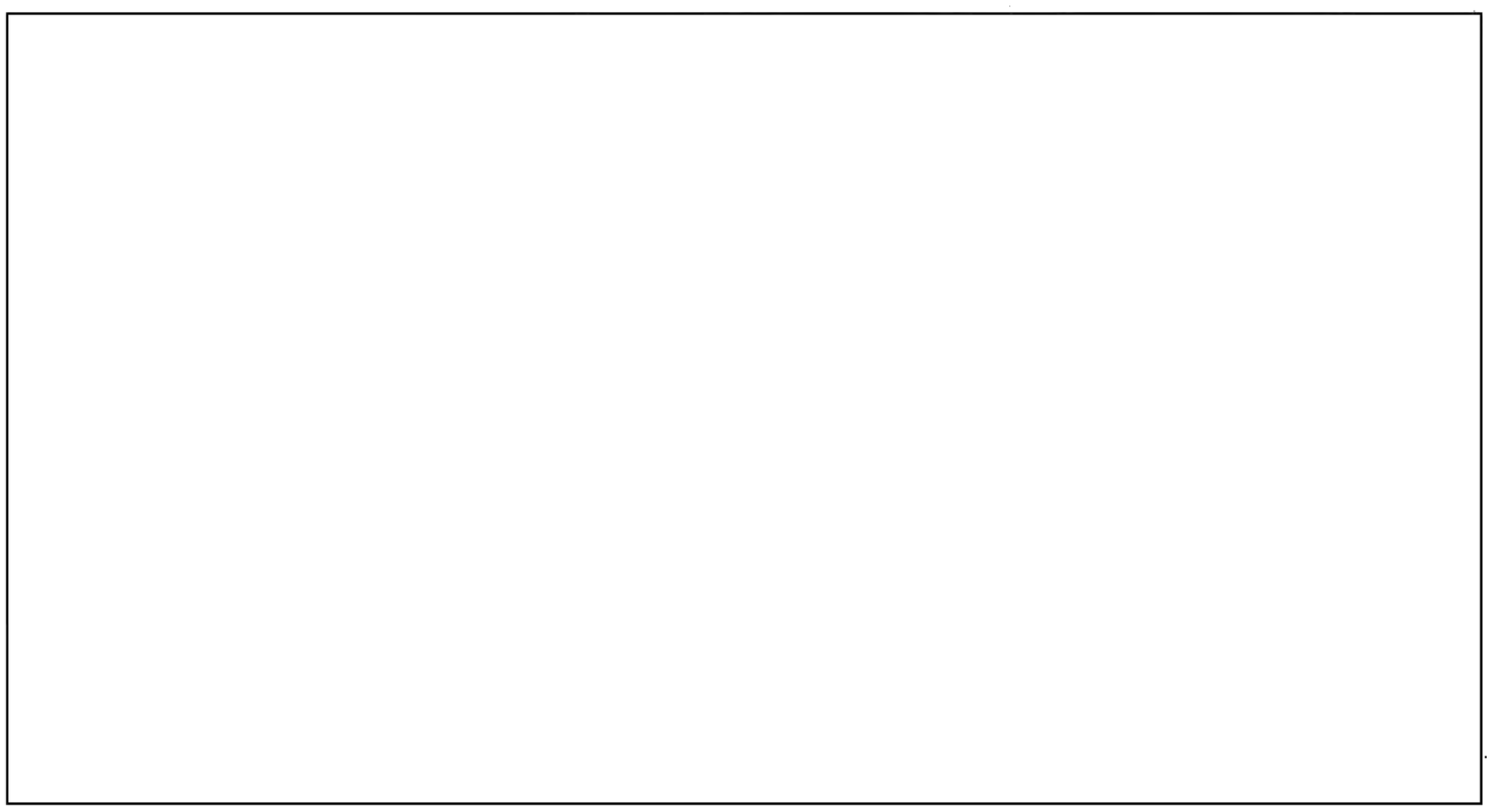
c. Spoof and/or saturate EW system - The duration of the L-Band signal of pass 34B (163 seconds) and the nature of the guidance commands (unrealistically small for an intercept of the vehicle) indicate there may have been an attempt to spoof the BLUE DOG jammer. Also, NPIC analysts indicated that within the limits of their photography of BX6734 there was a heavier than usual concentration of occupied SAM sites in the Hanoi area. Furthermore, BLACK SHIELD photography did not reveal any occupied sites in the Haiphong area. It may be that SAM Battalions were moved into the Hanoi area from other areas specifically in an attempt to concentrate fire on a repetitive area of BLACK SHIELD routes. This also enhanced, as far as the Soviets/Vietnamese may have concluded, their ability to saturate MAD MOTH.

d. Relevant finding resulting from pilot's comments: The pilot reported a missile rotating fairly fast about its vertical axis approximately 100-200 yards to the right of the aircraft and abeam the cockpit. The SA-2 Mod I missile rotating

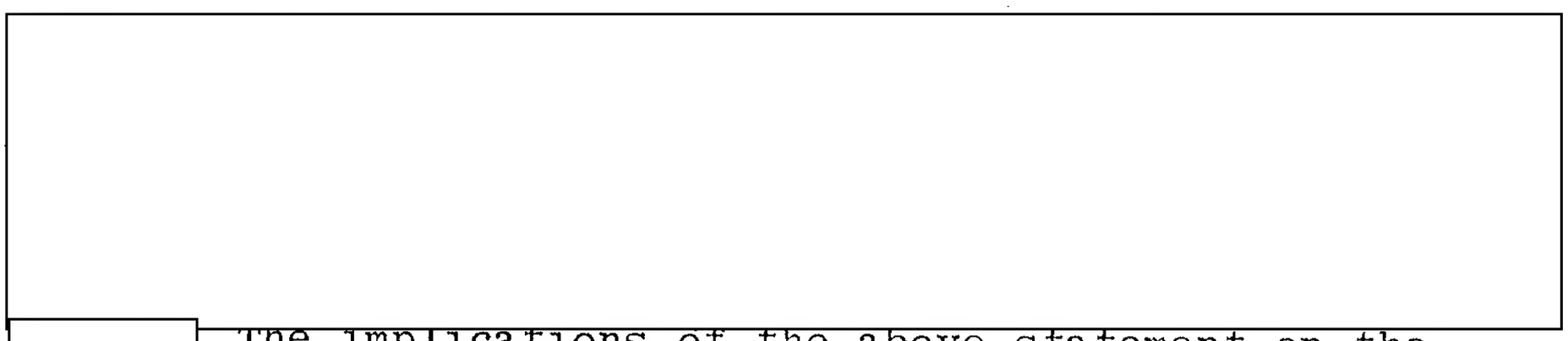
about its longitudinal axis, is a missile out of control and will no longer answer to any guidance commands. It seems extremely unlikely that an out of control missile could perform a "push over", dive and correct in azimuth to a dead stern position. It appears to be more probable that the pilot observed two different missiles; one climbing abeam of the aircraft, and another detonating some few seconds later to the rear of the aircraft. Although the rotation of the missile about its longitudinal axis may have been caused by the on-board jammers; it is not possible at this time to positively state that this was the actual cause of the rotation.

14. [redacted]

[redacted]



15. OXCART Vulnerability



The implications of the above statement on the

current OXCART vulnerability are: The increased launch range capability of the DRV SA-2 system launch in low PRF will definitely increase kill probability under conditions of OXCART jammer malfunction. The capability against the vehicle with fully operational ECM systems is still considered to be essentially zero.

[redacted]
JOHN PARANGOSKY
Acting Director of Special Activities

Attachments - 12
As Stated

CONCUR:

[redacted]
Office of Scientific Intelligence

[redacted]
Office of Elint

ATTACHMENTS:

I - BX6732 Overall Route, 28 October 1967
II - BX6732 Penetration Route Blow Up
III - BX6732 Sequence of Events
IV - BX6734 Overall Route, 30 October 1967
V - BX6734 Penetration Route Blow Up
VI - BX6734 Sequence of Events
VII - BX6734 Vapor Trail Analysis
VIII - [redacted]
IX - SA-2 Plan View - Launch Windows
X - OXCART Vulnerability vs SA-2
XI - MAD MOTH Response (34B)
XII - BLUE DOG Response (34B)

D/M/OSA/ [redacted] (20 Nov 67)
Distribution:
1 & 2 - DD/S&T (w/att)
3 - D/OEL (w/att)
4 - D/OSI (w/att)
5 - DDS&T Registry (w/att)
6 - D/SA (w/att)
7 - D/M/OSA (w/att)
8 - INTEL/O/OSA (w/att)
9 - D/O/OSA (w/att)
10 - OXC/O/OSA (w/att)
[redacted] - RB/OSA (w/o att)
11 - DD/SA, w/o att